

IN THE CLAIMS:

1. (Currently Amended) A method for encapsulating SCSI protocol for data transmission between two or more nodes across a packet-based network, comprising, at each node:

(a) identifying all other available nodes, and remote devices attached to each of said nodes, on said network;

(b) representing one or more of said remote devices such that they are made available to one or more local hosts;

(c) encapsulating an input/output (I/O) phase between one or more of said local hosts and one or more of said remote devices according to a packet-based protocol, wherein messages corresponding to the I/O phase are received by that node according to a second protocol that is different than the packet-based protocol; and

(d) repeating step (c) for subsequent I/O phases;  
wherein neither the one or more hosts nor the one or more remote devices communicate messages corresponding to the I/O phase using the packet-based protocol.

2. (Original) The method of Claim 1, wherein said input/output phase comprises a command phase, a data phase and a response phase.

3. (Original) The method of Claim 1, wherein encapsulating said I/O phase comprises encapsulating an individual command for a Fibre Channel or SCSI protocol.

4. (Original) The method of Claim 3, wherein said individual command is a task management function, an error recovery function or other I/O processing function.

5. (Original) The method of Claim 1, wherein each of said two or more nodes is communicatively connected to a Storage Area Network ("SAN").

6. (Original) The method of Claim 5, wherein each of said two or more nodes is an interface between its SAN and said packet-based network.

7. (Original) The method of Claim 5, wherein one of said SANs is a back-up library.

8. (Original) The method of Claim 1, wherein each of said nodes is a Fibre-Channel-to-SCSI router.

9. (Currently Amended) The method of Claim 1, wherein ~~said SCSI~~ said second protocol is a Fibre Channel ~~SCSI~~ protocol.

10. (Original) The method of Claim 1, wherein said packet-based network is an Asynchronous Transfer Mode ("ATM") network, an Ethernet network, an IP network or a SONET network.

11. (Original) The method of Claim 1, wherein said packet-based network is a wide are network ("WAN").

12. (Original) The method of Claim 1, wherein said packet-based network is a dedicated link.

13. (Original) The method of Claim 1, wherein said packet-based network is a switched network.

14. (Original) The method of Claim 1, wherein said representing step further comprises the steps of:

mapping a local address for each of one or more of said remote devices attached to a node to an intermediate address; and

mapping each of said intermediate addresses into a remote address at another node.

15. (Original) The method of Claim 1, wherein said encapsulating step further comprises the steps of:

converting said I/O phase from said SCSI protocol to a protocol associated with said packet-based network; and

converting back said I/O phase to said SCSI protocol at a remote node.

16. (Original) The method of Claim 15, wherein said protocol associated with said packet-based network is an Asynchronous Transfer Mode ("ATM") protocol, an Ethernet protocol, an IP protocol or a SONET protocol.

17. (Original) The method of Claim 1, wherein said identifying step further comprises dynamically discovering all other available nodes, and the devices attached to said nodes, through a common server.

18. (Original) The method of Claim 17, wherein at least one of said two or more nodes is designated as said common server.

19. (Original) The method of Claim 17, wherein said common server is a separate device from said nodes.

20. (Original) The method of Claim 17, further comprising a heartbeat message for determining, at said common server, if a node drops from said network.

21. (Original) The method of Claim 1, wherein said packet-based network is any network that allows data packets to flow between nodes.

22. (Original) The method of Claim 1, wherein different ones of said two or more nodes can be communicatively connected to a SAN using different network protocols.

23. (Currently Amended) A system for encapsulating SCSI protocol for data transmission between two or more nodes across a packet-based network, comprising, at each node, a set of instructions stored on a computer readable medium further comprising:

(a) instructions for identifying all other available nodes, and remote devices attached to each of said nodes, on said network;

(b) instructions for representing one or more of said remote devices such that they are made available to one or more local hosts;

(c) instructions for encapsulating an input/output (I/O) phase between one or more of said local hosts and one or more of said remote devices according to a packet-based protocol, wherein messages corresponding to the I/O phase are received by that node according to a second protocol that is different than the packet-based protocol; and

(d) instructions for repeating step (c) for subsequent I/O phases;  
wherein neither the one or more hosts nor the one or more remote devices communicate messages corresponding to the I/O phase using the packet-based protocol.

24. (Original) The system of Claim 23, wherein said input/output phase comprises a command phase, a data phase and a response phase.

25. (Original) The system of Claim 23, wherein all instructions are stored in memory within each of said nodes.

26. (Original) The system of Claim 23, wherein said instructions for encapsulating said I/O phase comprise instructions for encapsulating an individual command for a Fibre Channel or SCSI protocol.

27. (Original) The system of Claim 26, wherein said individual command is a task management function, an error recovery function or other I/O processing function.

28. (Original) The system of Claim 23, further comprising a Storage Area Network ("SAN") communicatively connected to each of said two or more nodes.

29. (Original) The system of Claim 28, wherein each of said two or more nodes is an interface between its SAN and said packet-based network.

29. (Original) The system of Claim 28, wherein at least one of said SANs is a back-up library.

30. (Original) The system of Claim 23, wherein each of said nodes is a Fibre-Channel-to-SCSI router.

31. (Original) The system of Claim 23, wherein said SCSI protocol is a Fibre Channel SCSI protocol.

32. (Original) The system of Claim 23, wherein said packet-based network is an Asynchronous Transfer Mode ("ATM") network, an Ethernet network, an IP network or a SONET network.

33. (Original) The system of Claim 23, wherein said packet-based network is a wide area network ("WAN").

34. (Original) The system of Claim 23, wherein said packet-based network is a dedicated link.

35. (Original) The system of Claim 23, wherein said packet-based network is a switched network.

36. (Original) The system of Claim 23, wherein said instructions for representing further comprise:

instructions for mapping a local address, for each of one or more of said remote devices attached to a node, to an intermediate address; and

instructions for mapping each of said intermediate addresses into a remote address at another node.

37. (Currently Amended) The system of Claim ~~36~~ 23, further comprising:

instructions for converting said I/O phase from said SCSI protocol to a protocol associated with said packet-based network; and

instructions for converting back said I/O phase to said SCSI protocol at a remote node,  
wherein said protocol associated with said packet-based network is an Asynchronous Transfer Mode ("ATM") protocol, an Ethernet protocol, an IP protocol or a SONET protocol.

38. (Original) The system of Claim 23, further comprising a common server, and wherein said instructions for identifying further comprise instructions for dynamically discovering all other available nodes, and the devices attached to said nodes, through said common server.

39. (Original) The system of Claim 38, wherein at least one of said two or more nodes is designated as said common server.

40. (Original) The system of Claim 38, wherein said common server is a separate device from said nodes.

41. (Original) The system of Claim 38, further comprising instructions for a heartbeat message to determine, at said common server, if a node drops from said network.

42. (Original) The system of Claim 23, wherein said packet-based network is any network that allows data packets to flow between nodes.

43. (Original) The system of Claim 23, wherein different ones of said two or more nodes can be communicatively connected to a SAN using different network protocols.

44. (Currently Amended) A method for encapsulating a first protocol for data transmission between two or more nodes across a network, comprising, at each node:

identifying all other available nodes, and remote devices attached to each of said nodes, on said network;

representing one or more of said remote devices such that said one or more of said remote devices are available to a local host;

encapsulating an input/output (I/O) phase between said local host and said one or more of said remote devices according to a packet-based protocol, wherein messages corresponding

to the I/O phase are received by that node according to a second protocol that is different than the packet-based protocol; and

repeating encapsulating said I/O phase for a subsequent I/O phase;

wherein neither the one or more hosts nor the one or more remote devices communicate messages corresponding to the I/O phase using the packet-based protocol.

45. (Previously Presented) The method of Claim 44, wherein said input/output phase comprises a command phase, a data phase and a response phase.

46. (Previously Presented) The method of Claim 44, wherein encapsulating said I/O phase comprises encapsulating an individual command for a Fibre Channel protocol.

47. (Previously Presented) The method of Claim 46, wherein said individual command is a task management function, an error recovery function or other I/O processing function.

48. (Previously Presented) The method of Claim 44, wherein encapsulating said I/O phase comprises encapsulating an individual command for a SCSI protocol.

49. (Previously Presented) The method of Claim 48, wherein said individual command is a task management function, an error recovery function or other I/O processing function.

50. (Previously Presented) The method of Claim 44, wherein each of said two or more nodes is communicatively connected to a Storage Area Network ("SAN").

51. (Previously Presented) The method of Claim 50, wherein each of said two or more nodes is an interface between its SAN and said packet-based network.

52. (Previously Presented) The method of Claim 50, wherein one of said SANs is a back-up library.

53. (Previously Presented) The method of Claim 44, wherein each of said nodes is a Fibre-Channel-to-SCSI router.

54. (Previously Presented) The method of Claim 44, wherein said first protocol is a Fibre Channel SCSI protocol.

55. (Previously Presented) The method of Claim 44, wherein said network is an Asynchronous Transfer Mode ("ATM") network, an Ethernet network, an IP network or a SONET network.

56. (Previously Presented) The method of Claim 44, wherein said network is a wide area network ("WAN").

57. (Previously Presented) The method of Claim 44, wherein said network is a dedicated link.

58. (Previously Presented) The method of Claim 44, wherein said network is a switched network.

59. (Previously Presented) The method of Claim 44, wherein representing further comprises:

mapping a local address for each of said one or more of said remote devices to a corresponding intermediate address; and

mapping said corresponding intermediate address into a corresponding remote address at another node.

60. (Previously Presented) The method of Claim 44, wherein encapsulating further comprises:

converting said I/O phase from said first protocol to a second protocol associated with said network; and

converting back said I/O phase to said first protocol at a remote node.

61. (Previously Presented) The method of Claim 60, wherein said second protocol is an Asynchronous Transfer Mode ("ATM") protocol, an Ethernet protocol, an IP protocol or a SONET protocol.



62. (Previously Presented) The method of Claim 44, wherein identifying further comprises dynamically discovering all other available nodes, and said remote devices attached to said nodes, through a common server.

63. (Previously Presented) The method of Claim 62, wherein at least one of said two or more nodes is designated as said common server.

64. (Previously Presented) The method of Claim 62, wherein said common server is separate from said nodes.

65. (Previously Presented) The method of Claim 62, further comprising detecting a heartbeat message for determining, at said common server, if a node drops from said network.

66. (Previously Presented) The method of Claim 44, wherein said network is any packet-based network that allows data packets to flow between nodes.

67. (Previously Presented) The method of Claim 44, wherein different ones of said two or more nodes can be communicatively connected to a SAN using different network protocols.

68. (Previously Presented) The method of Claim 44, wherein said first protocol is a SCSI protocol.

69. (Currently Amended) A computer readable medium having software embedded therein for using a system for encapsulating a first protocol for a data transmission between two or more nodes across a network, the computer readable medium comprising:

instructions for identifying all other available nodes, and remote devices attached to each of said nodes, on said network;

instructions for representing one or more of said remote devices such that said one or more of said remote devices are available to a local host;

instructions for encapsulating an input/output (I/O) phase between said local host and said one or more of said remote devices according to a packet-based protocol, wherein messages corresponding to the I/O phase are received by that node according to a second protocol that is different than the packet-based protocol; and

instructions for repeating said instructions for encapsulating for a subsequent I/O phase;  
wherein neither the one or more hosts nor the one or more remote devices  
communicate messages corresponding to the I/O phase using the packet-based protocol.

70. (Previously Presented) The computer readable medium of Claim 69, wherein said input/output phase comprises a command phase, a data phase and a response phase.

71. (Previously Presented) The computer readable medium of Claim 69, wherein each of said nodes comprises a corresponding computer readable medium comprising such software including such instructions.

72. (Previously Presented) The computer readable medium of Claim 69, wherein said instructions for encapsulating said I/O phase comprise instructions for encapsulating an individual command for a Fibre Channel protocol.

73. (Previously Presented) The computer readable medium of Claim 72, wherein said individual command is a task management function, an error recovery function or other I/O processing function.

74. (Previously Presented) The computer readable medium of Claim 69, wherein said instructions for encapsulating said I/O phase comprise instructions for encapsulating an individual command for a SCSI protocol.

75. (Previously Presented) The computer readable medium of Claim 74, wherein said individual command is a task management function, an error recovery function or other I/O processing function.

76. (Previously Presented) The computer readable medium of Claim 69, wherein the system further comprises a Storage Area Network ("SAN") communicatively connected to each of said two or more nodes.

77. (Previously Presented) The computer readable medium of Claim 76, wherein each of said two or more nodes is an interface between its SAN and said packet-based network.

78. (Previously Presented) The computer readable medium of Claim 76, wherein at least one of said SANs is a back-up library.

79. (Previously Presented) The computer readable medium of Claim 69, wherein each of said nodes is a Fibre-Channel-to-SCSI router.

80. (Previously Presented) The computer readable medium of Claim 69, wherein said first protocol is a Fibre Channel SCSI protocol.

81. (Previously Presented) The computer readable medium of Claim 69, wherein said network is an Asynchronous Transfer Mode ("ATM") network, an Ethernet network, an IP network or a SONET network.

82. (Previously Presented) The computer readable medium of Claim 69, wherein said network is a wide area network ("WAN").

83. (Previously Presented) The computer readable medium of Claim 69, wherein said network is a dedicated link.

84. (Previously Presented) The computer readable medium of Claim 69, wherein said network is a switched network.

85. (Previously Presented) The computer readable medium of Claim 69, wherein said instructions for representing further comprise:

instructions for mapping a local address, for each of one or more of said remote devices attached to a node, to a corresponding intermediate address; and

instructions for mapping each of said corresponding intermediate addresses into a corresponding remote address at another node.

86. (Previously Presented) The computer readable medium of Claim 69, wherein said software further comprises:

instructions for converting said I/O phase from said first protocol to a second protocol associated with said network; and

instructions for converting back said I/O phase to said first protocol at a remote node.

87. (Previously Presented) The computer readable medium of Claim 86, wherein said second protocol is an Asynchronous Transfer Mode ("ATM") protocol, an Ethernet protocol, an IP protocol or a SONET protocol.

88. (Previously Presented) The computer readable medium of Claim 69, wherein the system further comprises a common server, and wherein said instructions for identifying further comprise instructions for dynamically discovering all other available nodes, and said remote devices attached to said nodes, through said common server.

89. (Previously Presented) The computer readable medium of Claim 88, wherein at least one of said two or more nodes is designated as said common server.

90. (Previously Presented) The computer readable medium of Claim 88, wherein said common server is separate from said nodes.

91. (Previously Presented) The computer readable medium of Claim 88, further comprising instructions for detecting a heartbeat message to determine, at said common server, if a node drops from said network.

92. (Previously Presented) The computer readable medium of Claim 69, wherein said network is any packet-based network that allows data packets to flow between nodes.

93. (Previously Presented) The computer readable medium of Claim 69, wherein different ones of said two or more nodes can be communicatively connected to a SAN using different network protocols.

94. (Previously Presented) The computer readable medium of Claim 69, wherein said first protocol is a SCSI protocol.

95. (Original) The system of Claim 23, wherein said instructions for encapsulating further comprise:

instructions for converting said I/O phase from said SCSI protocol to a protocol associated with said packet-based network; and

instructions for converting back said I/O phase to said SCSI protocol at a remote node.

96. (New) A system for extending Fibre Channel networks comprising:

- a packet-based network operating according to a packet-based protocol;
- a first Fibre Channel network;
- a second Fibre Channel network;
- a first node connected to the first Fibre Channel Network and the packet-based network;
- a second node connected to the Second Fibre Channel Network and the packet-based network;

wherein the first node is operable to:

- discover the second node connected to the packet-based network and a remote device connected to the second node;
- represent the remote device to a host connected to the first node via the first Fibre Channel Network;
- receive a first message corresponding to an I/O phrase from the host to the remote device, wherein the first message formatted according to a fibre channel protocol;
- encapsulate the first message according to the packet-based protocol;
- forward the first message encapsulated according to the packet-based protocol to the second node via the packet-based network;
- receive a second message encapsulated according to the packet-based protocol from the second node via the packet-based network; and
- forward the second message to the host according to the Fibre Channel protocol via the first Fibre Channel network;

wherein the second node is operable to:

- receive the first message corresponding to an I/O phrase from the first node according to the packet-based protocol;
- forward the first message to the remote device according to the Fibre Channel protocol via the second Fibre Channel network;
- receive the second message corresponding to the I/O phase according to the Fibre Channel from the remote device protocol via the second Fibre Channel network;
- encapsulate the second message according to the packet-based protocol;
- forward the second message encapsulated according to the packet-based protocol to the first node via the packet-based network; and

forward the second message to the host according to the Fibre Channel protocol via the first Fibre Channel network.